MANGANESE

By Lisa A. Corathers

Domestic survey data and tables were prepared by Jesse J. Inestroza, statistical assistant, and the world production tables were prepared by Glenn J. Wallace, international data coordinator.

Manganese is essential to iron and steel production by virtue of its sulfur-fixing, deoxidizing, and alloying properties. Steelmaking, including its ironmaking component, has accounted for most of the domestic manganese demand, presently in the range of 85% to 90% of the total demand. Among a variety of other uses, manganese is a key component of certain widely used aluminum alloys and is used in oxide form in dry cell batteries. The overall level and nature of manganese use in the United States is expected to remain about the same in the near term. No practical technologies exist for replacing manganese with other materials or for using domestic deposits or other accumulations to reduce the complete dependence of the United States on foreign countries for manganese ore.

Domestic consumption of manganese ore, exclusive of the relatively small quantities used at iron and steel plants, was 398,000 metric tons (t), an increase of 11% compared with that of 2002 (table 1). Unit consumption of manganese in steel, as ferroalloys and metal, was 5.1 kilograms per metric ton (kg/t) of raw steel produced, as estimated from apparent consumption calculations. This level was slightly lower than the revised figure of 5.2 kg/t in 2002 and was the lowest since 1992 when it was 4.6 kg/t of raw steel produced.

As measured by the manganese content of manganese-containing material reported in U.S. foreign trade statistics and compared with that of 2002, manganese imports decreased by 8%. Manganese exports increased by 17% on a gross-weight basis and 15% on a content basis based on the typical manganese contents of the materials noted in table 5 plus that of manganese dioxide.

In 2003, the price of ore rose from that of 2002, as did the average prices of most ferroalloys. The amount of increase for the price of metallurgical-grade ore was about 7% internationally. The imported ferroalloys price increase on a year-average basis was 8% for medium-carbon ferromanganese and 12% for silicomanganese. The yearly average high-carbon ferromanganese price was about the same as that in 2002. In 2003, high-carbon and medium-carbon ferromanganese prices were at their highest at the end of the fourth quarter; prices for silicomanganese were highest at the beginning of the fourth quarter. In 2003, sales of manganese materials from the Government's National Defense Stockpile (NDS) reduced the Government's inventory of manganese by about 6% (content basis), leaving an inventory of about 1.6 times the annual domestic consumption. The larger disposals were of chemical- and metallurgical-grade ores.

World production of manganese ore in 2003 rose by 5% on a gross-weight basis and by 7% on a contained-weight basis, compared with that in 2002 (table 7). China was the leading producer on a gross-weight basis; South Africa was the leading producer on a contained-weight basis.

Most data in this report are rounded by the U.S. Geological Survey (USGS) to no more than three significant digits. Table footnotes indicate which statistics have been rounded.

Legislation and Government Programs

Stockpile.—The revised Annual Materials Plan (AMP) for fiscal year 2003 that the Defense National Stockpile Center (DNSC) of the Defense Logistics Agency issued on December 23, 2002, was the same with respect to manganese as in the revised fiscal year 2002 AMP issued on October 1, 2001. The revised fiscal year 2003 AMP covered the period from October 1, 2002, through September 30, 2003. Under this AMP, the maximum disposal authority for manganese materials was 226,796 t for metallurgical-grade ore; 36,287 t for chemical-grade ore; 27,216 t for natural battery-grade ore; 22,680 t for the manganese ferro group; 2,732 t for synthetic manganese dioxide; and 1,814 t for electrolytic manganese metal (Defense National Stockpile Center, 2003). The maximum disposal authority under an AMP is the maximum quantity of material that may be disposed in a given fiscal year; these may differ from the disposal authority quantities listed in table 2. The disposal authority quantities are the total quantities of materials remaining in inventory at the end of a given calendar year that have been authorized for ultimate disposal from the stockpile by Congress.

For 2003, disposals (reported sales) of manganese materials announced by the DNSC totaled 229,938 t for stockpile-grade metallurgical-grade ore; 40,578 t for chemical-grade ore; 34,018 t for high-carbon ferromanganese; 24,583 t for natural battery-grade ore; and 1,472 t for electrolytic metal. All disposals were cash transactions.

NDS physical inventory of manganese materials, in gross weight, indicated that except for synthetic manganese dioxide (unchanged) and stockpile-grade metallurgical ore (9,371 t), all inventories decreased. The decreases consisted of 44,974 t for natural battery-grade ore; 38,473 t for nonstockpile-grade metallurgical-grade ore; 35,593 t for high-carbon ferromanganese; 1,641 t for electrolytic manganese metal; and 229 t for chemical-grade ore (Defense National Stockpile Center, unpub. data, 2003). In 2003, the estimated manganese content of manganese inventories being held by the Government at yearend was lowered by about 6% to 1.03 million metric tons (Mt) (table 2). On the basis of manganese content, the total remaining inventory was about 1.7 times the current national apparent consumption.

Drinking Water.—In July, the U.S. Environmental Protection Agency (EPA) made its final determination that no regulatory action was necessary for manganese in drinking water (U.S. Environmental Protection Agency, 2003a). Because manganese is an essential nutrient, the EPA noted that concern over potential toxic effects from high oral exposure must be balanced against concern for adverse health effects resulting from a manganese deficiency in the diet.

Air Quality.—The EPA issued final national emission standards for hazardous air pollutants (HAPs) for several industrial sources during the year, including brick and structural clay products and clay ceramics manufacturing; chemical recovery combustion sources at kraft, soda, sulfite, and stand-alone semichemical pulp mills; integrated iron and steel manufacturing; and taconite iron ore processing. One of the metallic HAPs at each of these sources is manganese. The EPA used particulate matter (PM) as a surrogate limit for the metal HAPs. Emission limits vary depending on the emission sources at the plants and whether the sources were existing or new. PM emissions at exisiting semichemical pulp mills were 0.10 kilogram per million grams (kg/Mg) (20 pounds per metric ton) of black liquors fired from kraft and soda smelt dissolving tanks and 4.535 kilograms per hour (10 pounds per hour) for the hog fuel dryer at Weyerhaeuser Paper Company's Cosmopolis, WA, facility (U.S. Environmental Protection Agency, 2003c). At brick and structural clay products and clay ceramics manufacturing plants, PM emission limits ranged from 0.060 kg/Mg (0.12 pounds per ton) of fired product for new large tunnel kilns to 0.21 kg/Mg (0.42 pounds per ton) of fired product for existing large and new small kilns (U.S. Environmental Protection Agency, 2003b). PM emission limits at integrated iron and steel manufacturing plants ranged from the lowest at 0.003 grains per dry standard cubic foot for blast furnace casthouses to the highest for existing sinter windboxes at 0.4 pound per ton of sinter (U.S. Environmental Protection Agency, 2003d). PM emission limits at taconite iron ore processing facilities ranged from the lowest at 0.005 grain per dry standard cubic foot for new finished pellet handling areas to 0.052 grain per dry standard cubic foot for existing ore dryers (U.S. Environmental Protection Agency, 2003e).

Sewage Use and Disposal.—In December, the EPA published the results of its review of regulations under the Clean Water Act governing the use and disposal of sewage sludge. Manganese was one of 15 pollutants in sewage sludge the EPA identified as requiring a more refined risk assessment and characterization to determine whether further regulation is warranted. Of particular concern is the impact that manganese may have on human health from the disposal of sewage sludge in surface lagoons and on aquatic communities from the use of sewage sludge in agricultural land applications (U.S. Environmental Protection Agency, 2003f).

Production

Ore and Concentrate.—The only mine production of manganese in the United States consisted of small amounts of manganiferous material having a natural manganese content of less than 5%. This type of material was produced in South Carolina for use in coloring brick.

Ferroalloys, Metal, and Synthetic Dioxide.—Production statistics for these materials were not published to avoid disclosing company proprietary data. Two companies produced manganese ferroalloys domestically—Eramet Marietta Inc. in Marietta, OH, and Highlanders Alloys LLC in New Haven, WV. Highlanders ceased production in January (table 3). In April, Rollock, Inc. reportedly had opened a new ferromanganese division in Johnstown, PA, to process ferromanganese-bearing slag left over by blast furnaces in the Johnstown area (Ryan's Notes, 2003a; Murtha, 2003§[1]). As of September 2004, no further information on company activities was available. Synthetic manganese dioxide was produced by the following companies: Erachem Comilog, Inc. at its Baltimore, MD, and New Johnsonville, TN, plants; Eveready Battery Company, Inc. (Energizer Holdings, Inc.) in Marietta, OH; and Kerr-McGee Chemical LLC in Henderson, NV. In September, Kerr-McGee placed its electrolytic manganese dioxide plant on standby owing to low-priced imports and high inventory levels (Chemical Market Reporter, 2003). The plant has production capacity of 29,000 metric tons per year (t/yr).

Consumption, Uses, and Stocks

Data relating to manganese end use and certain other information have indicated that metallurgical applications account for most domestic manganese consumption, 85% to 90% of which has been for steelmaking. This usage pattern is typical for most industrialized countries (Mining Magazine, 1990). Reported U.S. ore consumption in 2003 indicated that unit consumption of manganese in ironmaking, which could not be published to avoid disclosing company proprietary data, declined from that of 2002 to become an even smaller and relatively minor component of overall manganese use in steelmaking. Reported U.S. consumption of manganese ferroalloys and metal in 2003 are presented in table 4. Reported consumption (gross weight) of ferromanganese and manganese metal decreased slightly from that in 2002, by 2% and 1%, respectively, while silicomanganese consumption increased by 9%. Data in this table are not directly comparable with those for years prior to 1998, especially for ferromanganese. Also, because of the incompleteness of reporting to the USGS's voluntary consumption survey, the figures in this table are more representative of relative rather than absolute quantities. The combination of the indicated consumption pattern with estimates of apparent consumption suggests that manganese unit consumption in steelmaking in 2003 was about 5.1 kg/t or about twice that if calculated on the basis of reported consumption. In 2003, U.S. manganese apparent consumption was an estimated 618,000 t.

Relatively small quantities of manganese were used for alloying with nonferrous metals, chiefly in the aluminum industry as manganese-aluminum briquettes that typically contained either 75% or 85% manganese. Manganese plays an important alloying role in aluminum to increase corrosion resistance. The most important use of aluminum-manganese alloys is in the manufacture of soft drink cans. Other uses include automobiles, cookware, radiators, and roofing (Harben and others, 1998).

---

[1]References that include a section mark (§) are found in the Internet References Cited section.

In 2003, domestic consumption of manganese ore increased by 11% to 398,000 t, while corresponding yearend stocks increased by 3% to 156,000 t (table 1). To avoid disclosing company proprietary data, these figures exclude the relatively small quantities associated with ironmaking and cannot be disaggregated into end-use segments.

Comparatively small amounts of manganese were used domestically in animal feed, brick coloring, dry cell batteries, fertilizers, and manganese chemicals. These were among the many nonmetallurgical applications of manganese (Weiss, 1977; Harben and others, 1998). The source of manganese units for these applications was mainly manganese ore.

Data on domestic consumption of manganese ore, exclusive of that consumed within the steel industry, are collected by means of the "Manganese Ore and Products" survey. In 2003, 16 firms were canvassed that process ore or had processed ore in the past by such methods as grinding and roasting or that consume it in the manufacture of dry cell batteries and manganese ferroalloys, metal, and chemicals. Of those 16 companies, 8 consumed manganese ore in their processes. The collective consumption of these firms is believed to constitute all of the manganese ore consumption in the United States, exclusive of that by the steel industry. Full-year responses or a basis upon which to estimate the data were obtained from all of these firms for 2003.

Primary or nonrechargeable alkaline batteries, in which electrolytic manganese dioxide (EMD) is used, continued to expand their share of the market at the expense of the carbon-zinc batteries, in which natural battery-grade ore is a component. Primary batteries continue to find growing applications, particularly in digital cameras. Matsushita Battery Industrial Co., Ltd. introduced a new, higher power alkaline battery for digital cameras, and Sanyo Energy (USA) Corporation introduced a new primary lithium-manganese dioxide cell which can replace two alkaline "AA" cells (MacArthur and Blomgren, 2003, p. 13). In the secondary or rechargeable battery market, lithium-based technologies, including lithium-ion batteries comprising lithium manganese oxides, are gaining ground rapidly on nickel-metal-hydride and nickel-cadmium cells. Lithium batteries recharge faster than nickel ones and are very light weight. They are currently used in consumer electronics (cell phones, laptop computers, and PDAs) and in military electronics (radios, mine detectors, and thermal weapons sights) (Ehrlich, 2002, p. 35.1). In 1992, the United States accounted for almost 50% of the secondary battery market; today, the market is about equally divided between North America, Europe, and Asia (MacArthur and Blomgren, 2003, p. 1).

Prices

For 2003, if the price of manganese in metallurgical-grade ore is set at 1.0, the corresponding price per manganese unit was approximately 5.7 for manganese metal, 5.4 for silicomanganese, 4.0 for medium-carbon ferromanganese, and 2.6 for high-carbon ferromanganese. All factors increased compared with those in 2002, except that for high-carbon ferromanganese, which remained about the same. The factors are based on year-average prices for ferroalloys derived from prices listed in Platts Metals Week and for metal as given in Ryan's Notes (North American transaction prices).

Manganese Ore.—The USGS estimated the average price of metallurgical-grade ore containing 48% manganese to be about $2.41 per metric ton unit. Prices were somewhat above or below this value, depending on ore quality, time of year, and nature of transaction. The price of a metric ton of ore is obtained by multiplying the metric ton unit price by the percentage manganese content of the ore; for example, by 48 when the manganese content is 48%. The ore market consisted of a number of submarkets because of differences between ores according to such various end uses as ferroalloy production, blast furnace ironmaking, and manufacture of manganese chemicals.

The price of manganese in ore in 2003 and 2002 was 24.1 and 23.0 cents per kilogram, respectively. These values indicate an increase of 5% in U.S. cost, insurance, freight price or somewhat less than the increase in free on board (f.o.b.) price in international markets.

In 2003, the international benchmark price for metallurgical-grade ore increased by 7% from that in 2002. Price negotiations between BHP Billiton Ltd. and major Japanese consumers were concluded in August 2002. On an f.o.b. basis per metric ton unit for delivery during the annual contract year, the agreed price was $2.12 for ore from the Groote Eylandt Mine in Australia (Ryan's Notes, 2003c).

Manganese Ferroalloys.—Prices for high- and medium-carbon ferromanganese increased from the beginning of 2003 to the end of the year, generally mirroring the growth in the domestic and world raw steel production rate. Silicomanganese prices increased as a result of improved crude steel demand with silicomanganese supply deficits in the world market (CRU Bulk Ferroalloys Monitor, 2003).

The price information that follows pertains to quotations for U.S. imports from Platts Metals Week because public information on current prices for domestic product was not available. All prices are based on free market spot prices per unit of measurement, f.o.b. Pittsburgh, PA; Chicago, IL; or Houston, TX, warehouse. English units were the basis for price quotes in the United States.

For ferromanganese, the price range for high-carbon grade containing 78% manganese began the year unchanged from the end of 2002 at $495 to $515 and ended the year at $580 to $605, for a net increase of about 17%. For the year, the average for the middle of the price range was $493.73, about the same as that of 2002. The price range for medium-carbon ferromanganese with a manganese content of 80% to 85% and a nominal carbon content of 1.5%, per pound of manganese, began the year unchanged from the end of 2002 at 45 to 48 cents and ended the year at 50 to 53 cents, for a net increase of 11%. The middle of the price range averaged 43.24 cents for the year, for an increase of 8% above that of 2002.

For imported silicomanganese with 2% carbon, the price range, per pound of alloy, started the year unchanged from that at the end of 2002 at 24 to 25 cents and ended the year at 31 to 33 cents, for a net increase of 31%. The middle of the price range averaged 27.26 cents, for an increase of 12% compared with that of 2002.

Manganese Metal.—According to the North American transaction prices listed by Ryan's Notes, bulk shipments of domestic manganese metal, f.o.b. shipping point, started the year unchanged from 50 to a revised 54 cents per pound at yearend 2002 and ended the year at 73 to 76 cents per pound, a net increase of 43% for the year. Prices increased steadily until a slight decrease of 59.5 to 61.5 cents in July to early August, after which point prices generally trended upwards. The year-average price of 61.89 cents for this listing was 15% greater than that for 2002.

Foreign Trade

Compared with those of 2002, on a gross weight basis, total manganese exports, including 4,470 t of manganese dioxide, increased by 17% (table 5). Total manganese imports decreased by 9%[2] (table 6). In terms of manganese units contained, exports (including 2,680 t of manganese dioxide) increased by 15%, while imports decreased by 8%[2]. The content of exports was calculated based on the typical manganese contents of the manganese materials noted in table 5 plus that of manganese dioxide. The content of imports was calculated based on the reported trade data plus the estimated manganese content of 100% for manganese metal. Also on the basis of content, the ratio of imports of manganese ferroalloy plus metal to imports of ore plus dioxide increased to 1.92:1 in 2003 from 1.74:1 in 2002. In the absence of domestic mine production, U.S. net import reliance, as a percent of apparent consumption, was 100% for manganese, the same as it has been for the past 18 years. Unless otherwise noted, the ensuing comparisons of foreign trade data were made on the basis of manganese content.

Exports of manganese ore, manganese ferroalloys, and manganese dioxide increased during 2003, while exports of manganese metal decreased. The biggest year-to-year changes were for exports of manganese dioxide and manganese ore, which increased by 23% and 22%, respectively, compared with those in 2002. Compared with those in 2002, exports of silicomanganese and ferromanganese increased by 16% and 15%, respectively, while exports of manganese metal increase by 6%.[2]

On a gross weight basis, reexports of ore, ferromanganese, silicomanganese, metal, and dioxide were 86,800 t, 3,640 t, 3,160 t, 217 t, and 147 t, respectively (U.S. Census Bureau, unpub. data, 2003). Except for manganese ore and manganese dioxide, all or nearly all reexports went to Canada. Other main destinations of metal reexports were Italy and the Republic of Korea. The majority of manganese dioxide reexports went to Canada (45%), with the remaining going to Australia and South Africa. The majority of manganese ore reexports went to China (92%), and the remaining reexports went to Canada, Germany, Hong Kong, and the Netherlands.

Among imports, the overall average manganese contents were 78.6% for ferromanganese and 50.4% for ore. Ferromanganese imports consisted of the following: high-carbon ferromanganese, which contains more than 4% carbon; medium-carbon ferromanganese, which contains more than 1% to 4% carbon; and low-carbon ferromanganese, which contains 1% or less carbon. Imports of total ferromanganese fell by 14% from those in 2002. The most significant year-to-year change was for imports of high-carbon ferromanganese, which were 23% less than those of 2002. Decreases in this import subcategory were especially notable for India, from which no shipments were received in 2003. High-carbon ferromanganese imports increased for Australia (199%), and decreased for France (16%), South Africa (14%), and Brazil (10%). Comparing leading supplying countries of medium-carbon ferromanganese with those in 2002, imports increased for China (184%), Norway (183%), and Mexico (13%), and decreased for the Republic of Korea (44%) and South Africa (13%). No imports of medium-carbon ferromanganese were received from Brazil or Ukraine during 2003. Low-carbon ferromanganese imports from Mexico were about 80 times those of 2002, while imports from Norway, Japan, and China were quadruple, triple, and double, respectively.

Silicomanganese imports rose by 11% from those of 2002. Comparing leading supplying countries of silicomanganese with those in 2002, imports increased for Spain (151%), Norway (124%), Georgia (74%), Romania (60%), and Mexico (50%), and decreased for India (100%), France (52%), South Africa (9%), and Australia (1%). Manganese metal imports, on a gross weight basis, were 33% lower than for 2002. The bulk of metal imports (86%) consisted of unwrought manganese imports primarily from South Africa (66%) and China (32%). Imports in the "other manganese, wrought" subcategory were almost five times those of 2002. Waste and scrap metal imports decreased by 81% from those of 2002. Imports of spiegeleisen (pig iron containing about 20% manganese) decreased to 292 t in 2003 from 413 t in 2002, on a gross weight basis, with a total customs value of $331,704 or $1,136 per metric ton. The majority of these imports were from South Africa (92%), with the remaining from Spain (8%) (U.S. Census Bureau, unpub. data, 2003).

Among imports of manganese chemicals, on a gross weight basis, those of manganese dioxide increased by 35% from those in 2002. Australia continued to be the leading source of manganese dioxide, supplying 59% of the imports. Manganese dioxide imports from South Africa were once again greater than those from Ireland, and triple those from South Africa in 2002. Imports of potassium permanganate decreased to 1,470 t in 2003 from 1,540 t in 2002, on a gross weight basis. The leading sources for potassium permanganate imports continued to be the Czech Republic and India, with 61% and 39%, respectively, in 2003. U.S. Census Bureau data for imports under the classification of "sulfates, alums, peroxosulfates, other (manganese)" (not listed in table 6) suggested that imports of manganese sulfate, on a gross weight basis, increased by 18%, as the imports of material in that class increased by 65% for China, while decreasing by 3% for Mexico. Receipts from China in 2003 were 23,100 t valued at $7.0 million, up from 14,000 t in 2002, and those from Mexico were 16,900 t valued at $8.5 million, down from 17,400 t in 2002 (U.S. Census Bureau, unpub. data, 2003).

[2]Revised on April 18, 2005.

Manganese Metal Flake Imports.—On January 10, the President of the United States issued Presidential Proclamation 7637, which granted duty-free status of unwrought metal flake [Harmonized Tariff Schedule of the United States (HTS) subheading 8111.00.47.00] to any sub-Sahara African beneficiary country, as designated under the African Growth and Opportunity Act, that produces them (President of the United States, 2003). The proclamation essentially applies to South Africa, the only sub-Sahara African country that produces manganese flake. The proclamation also called for the phaseout by January 1, 2005, of the 5.6% tariff on unwrought manganese flake and other unwrought manganese imports from Jordan established under the United States-Jordan Free Trade Area Implementation Act.

Pending U.S.-Southern African Customs Union Free Trade Agreement.—In April, the U.S. International Trade Commission (ITC) submitted its confidential probable-economic-effect report on the pending Southern African Customs Union Free Trade Agreement (FTA) to the United States Trade Representative (USTR) (U.S. International Trade Commission, 2003b§). A public version of the report has not yet been released.

On June 2, the USTR launched negotiations for the FTA with the member nations of the Southern African Customs Union—Botswana, Lesotho, Namibia, South Africa, and Swaziland (Office of the United States Trade Representative, 2003§). The FTA could result in the permanent elimination of the 14% ad valorem duty on all imports of unwrought manganese—manganese flake (HTS subheading 8111.00.47) and "other" unwrought manganese articles, such as manganese powder and manganese-aluminum briquettes (HTS subheading 8111.00.49)—from South Africa.

Administrative Reviews.—On May 1, the International Trade Administration (ITA) of the U.S. Department of Commerce announced the opportunity to request an administrative review of the antidumping duty order covering silicomanganese imports from India, Kazakhstan, and Venezuela for the period November 9, 2001, through April 30, 2003 (International Trade Administration, 2003a). Based on a request from Considar, Inc., the ITA announced the beginning of an administrative review for the subject silicomanganese imports from Kazakhstan in July (International Trade Administration, 2003b, c).

On August 11, the ITC initiated an antidumping investigation of EMD imports from Australia, China, Greece, Ireland, Japan, and South Africa in response to a petition filed on July 31 by Kerr-McGee (U.S. International Trade Commission, 2003). The ITC held a conference to hear oral presentations in connection with the investigation on August 21. On September 12, the ITC voted to continue its antidumping investigations of EMD imports from Australia, Greece, Ireland, Japan, and South Africa, but not those from China. The ITC made a finding of negligibility with respect to Chinese EMD imports; imports are generally deemed "negligible" if they amount to less than 3% of the total within the most recent 12-month period preceding the filing of the petition (U.S. International Trade Commission, 2003a§). However, the ITC terminated the antidumping duty investigation on March 9, 2004, based on Kerr-McGee's withdrawal of its antidumping petitions (U.S. International Trade Commission, 2004). The ITA ended its corollary antidumping duty investigation on March 2, 2004 (International Trade Administration, 2004a).

On October 27, 2003, the ITA issued a preliminary antidumping duty margin of 2.12% on imports of silicomanganese from Brazil's Eletrosiderurgica Brasileira SA (SIBRA), Companhia Paulista de Ferroligas (CPFL), and Urucum Mineracao S.A. for the period of December 1, 2001, through November 30, 2002. These companies are all subsidiaries of Brazilian mineral producer Companhia Vale do Rio Doce (CVRD). Prior to this preliminary ruling, the antidumping duty margin for such imports was 88.87% (International Trade Administration, 2003d). The ITA issued a final antidumping duty margin of 13.02% on the subject imports on March 24, 2004; this duty margin was subsequently amended to 16.5% on May 24, 2004 (International Trade Administration, 2004b, c).

World Review

The bulk (98%) of manganese ore was produced in 10 countries. On a content basis, the leading producer countries of manganese ore were, in decreasing order, South Africa, Australia, Brazil, Ukraine, Gabon, China, and India (table 7). On a gross weight basis, the leading producer countries of manganese ferroalloys were, in decreasing order, China, South Africa, Ukraine, Norway, Japan, France, Brazil, and India (table 8).

Australia.—In September, HiTec Energy Ltd. completed its acquisition of an existing solvent extraction/electrowinning plant from ABN AMRO located adjacent to the OMG Cawse Nickel facility 50 kilometers northwest of Kalgoorlie (HiTec Energy Ltd., 2003b§). The company planned to convert the plant to EMD production using a phased approach. By the third quarter of 2004, the company planned to spend A$47 million (US$31 million) to begin plant operations at a capacity of 10,000 t/yr. The company would increase production capacity to 19,000 t/yr (A$51 million or US$33.6 million) in 2005 and to 23,000 t/yr (A$13 million or US$8.6 million) in 2006 (HiTec Energy Ltd., 2003a§).

Brazil.—On October 28, CVRD announced it had restructured its manganese ferroalloy business. SIBRA was renamed Rio Doce Manganese S.A. (RDM). The operations of CVRD subsidiaries, including CPFL, would be transferred to RDM starting in January 2004. The main RDM assets are the Azul Mine located in Carajas, State of Para, and a manganese ferroalloy plant located in Simoes Filho, State of Bahia, as well as CPFL's four ferroalloy plants in the State of Minas Gerais. RDM will have a total production capacity of 2,330,000 t/yr of manganese ore and 350,000 t/yr of manganese ferroalloys. CVRD manganese and ferroalloy operations will be held through four wholly owned subsidiaries—RDM; Urucum Mineracao S.A. in Corumba, State of Mato Grosso do Sul; Rio Doce Manganese Europe in Dunkerque, France; and Rio Doce Manganese Norway in Mo I Rana, Norway (Companhia Vale do Rio Doce, 2003§).

Bulgaria.—Olberg Holdings AG, which acquired the Obrochiste manganese project from the Government of Bulgaria, began work on completing and equipping a large shaft (up to 500,000 t/yr) that was started in 1982. The company planned to start production in early 2004 (Mining Journal, 2003).

China.—In July, Eramet SA announced it had closed its Shaoxing ferromanganese production facility located in the Zhejiang Province on April 12 (TEX Report, 2003). The plant, which had an production capacity of 100,000 t/yr, was closed because of the Chinese Government's intention of moving heavy industry out of Shaoxing (Yieh Trading Corporation Market News, 2003§). Current levels of ferromanganese production in China were expected to be maintained by two plants—Guilin Ferro-Alloy Works and Bayi Manganese Ferro-Alloy Works—located in the Guangxi Autonomous Region (TEX Report, 2003).

France.—On September 5, Comilog France (part of the Comilog Group in which Eramet owns 60%) announced that it would close its Boulogne-sur-Mer high-carbon ferromanganese plant in France by the end of the year. The company cited several reasons for the closure, as follows: 1) growing competition from low-cost countries; 2) increasing unsuitability of product to meet market requirements, particularly in Western Europe; 3) unfavorable production cost trends, particularly owing to substantial, long-term price increases in coke feedstock; 4) the company's inability to further reduce the plant's fixed costs substantially; and 5) failure of the new blast furnace to completely restore the plant's competitiveness (Eramet SA, 2003§).

India.—On May 12, India's Ministry of Disinvestment opened the bidding process for the Government's 51% equity in Manganese Ore India Ltd. (MOIL) as well as the Madhya Pradesh State Government's 8.81% stake in the company. The Maharashtra State Government may also sell its 9.62% share in the company (India Ministry of Disinvestment, 2003§). Bids were to be accepted until June 23. In May 2004, the Steel Minister of India asked for the withdrawal of MOIL from the disinvestments list (Ieport Daily News, 2004§). As of August 1, 2004, the Ministry of Disinvestment had not yet made a decision.

Ireland.—In July, Mitsui Denman Ireland (a subsidiary of Mitsui Mining and Smelting Co.) announced it would be permanently closing its EMD plant in County Cork (RTÉ News, 2003§). South Coast Transport acquired the property in December and planned to open a construction and demolition transfer station by yearend 2004 (Sunday Business Post, 2003§).

Norway.—Rio Doce Manganese Norway (RDMN) (a wholly owned subsidiary of CVRD) started manganese ferroalloy production on June 30. RDMN, formerly Elkem Rana, was acquired by CVRD in February 2003. The plant will produce silicomanganese and high-carbon ferromanganese by consuming manganese ore fines supplied by CVRD's Azul Mine (Bradespar S.A., 2003§).

In early November, Eramet was reported to be in the process of converting a silicomanganese furnace at one of its Norwegian plants to produce high-carbon ferromanganese as a result of the closure of its Boulogne-sur-Mer high-carbon ferromanganese plant in France by yearend. The converted furnace will have a production capacity of 50,000 t/yr, with all production to be sold in Europe (Platts Metals Week, 2003).

Russia.—Marganets Komi announced plans to start construction on a mill in the Republic of Komi in 2003 to enrich ores mined from the Parnokskoye iron-manganese ore deposit. The company expected the mill to be operational by 2006, at which time the company expected to sell 50,000 t/yr of manganese ore concentrate produced from 80,000 to 100,000 t/yr of mined ore. The company also indicated it would double ore production to 50,000 t/yr in 2003 (Interfax Mining & Metals Report, 2003a).

In May, Kosogorsk Steel Works, located near Tula, restarted its No. 3 blast furnace. The furnace, which has undergone a US$6.5 million revamp, has production capacity of 1,000 metric ton per day (t/d) of cast iron or 600 to 700 t/d of ferromanganese (Metal Pages, 2003§).

South Africa.—On March 10, the South African Government issued a proposed Mineral and Petroleum Royalty Bill for public review and comment (South African National Treasury, 2003b§). The bill would require manganese mine operators to pay a 2% ad valorem royalty on gross quarterly sales. The comment deadline was extended to April 30, 2003 (South African National Treasury, 2003a§). Action on the proposed bill was still pending in August 2004.

Assmang Limited reported it had spent R77.0 million (US$11.6 million) in the second half of 2003 on construction of its new No. 3 shaft complex at the Nchwanning manganese mine. The company expected production from the new shaft to begin during May 2004 (Assmang Limited, 2004§).

In its 2003 annual report, Delta plc reported it would be increasing EMD capacity by 9,000 t/yr during 2004 with the commissioning of additional production cells (Delta plc, 2004§). In 2002, the company announced plans to ultimately increase EMD production at its Nelspruit plant to 50,000 t/yr from 33,000 t/yr (Industrial Minerals, 2002). The expansion in 2004 would bring the plant's operating capacity to 42,000 t/yr.

Ukraine.—In late May, the Pridniprovye consortium of the Dnipropetrovsk region in Ukraine purchased the Government's 25% stake in Nikopol Ferroalloys Plant from the Ukrainian State Property Fund (Interfax Mining & Metals Report, 2003b). In June, Nikopol appointed CC Metals and Alloys, Inc. as its exclusive agent for its manganese alloy sales in Canada, Trinidad, and the United States (Ryan's Notes, 2003b).

Current Research and Technology

Among many items in the current literature that reported on various aspects of manganese and the topics addressed were the following:

Biology.—Reports on the effects of occupational exposures on workers in a South African manganese smelter, and the utility of biological monitoring in those same workers (Myers, Thompson, Naik, and others, 2003; Myers, Thompson, Ramushu, and others, 2003); a study indicating less effect on dopamine transporter site functioning in the putamen—a nerve cell in the brain that helps regulate motor performance—in individuals with manganism than those with Parkinson's disease (Huang and others, 2003); results showing that teeth can successfully be used as a biomarker for tracking manganese levels in animals, including by exposure type and time (Miller and others, 2003); and an indication that while the renal systems of male rats are more sensitive to high levels of manganese given orally than those of female rats, male rats may confound data relating the assessment to human risk (Ponnapakkam and others, 2003).

Electrochemistry of Manganese Oxides.—The use of graphite powder to enhance the conductivity of EMD or chemical manganese dioxide in primary and secondary alkaline batteries (Barsukov and others, 2003); development of manganese-manganese oxide thin films as a possible replacement for more costly ruthenium oxides in electrochemical supercapacitor applications (Djurfors and others, 2003); and a study on the effects of the aluminum-manganese stoichiometric ratio on electrochemical properties of hydrogen storage alloys (Wu and others, 2003).

Environment and Toxicology.—Reported environmental technologies involving manganese materials, including the use of potassium permanganate to regenerate manganese greensand used to remove iron and manganese from potable and industrial process waters (Mangum, 2003); the recycling of manganese and other metals from spent zinc-manganese batteries by vacuum metallurgy (Chen and others, 2003); the development of a regenerable manganese-based sorbent to remove sulfur, and possibly hydrochloric and hydrofluoric acids, from dry coal gas (Bakker and others, 2003); and a report on the distribution of manganese and other metals in various composts and amended soils (Liu and others, 2003).

Extractive Pyrometallurgy.—Research on sintering raw materials to prepare silicomanganese feedstocks, including low-grade manganese-carbonate-ore-coal pellets (Peretyagin and Pavlov, 2003), and low-grade manganese concentrates (less than 32% manganese content) and silicomanganese slag (Dmitriev and others, 2003).

Extractive Hydrometallurgy.—Results on bench-scale testing of leaching low-grade manganese oxide ores with sulfur dioxide at 50% pulp density to form a highly concentrated manganese sulfate solution (Naik and others, 2003).

Ferrous Alloys.—Results from numerous experiments involving manganese ferroalloys, including the reduction of manganese and silicon from no-iron and low-iron (4% iron oxide) slags by carbon in the hot metal (Krivolapov and others, 2003); deoxidation of ferrous-nickel melts with manganese and silicon (Dashevskii and others, 2003); effect of solute carbon content, as well as chromium, boron, and manganese additions, on the warm rolling behavior of low-carbon steels (Toroghinezhad and others, 2003); effect of manganese segregation on fine-grained ferrite structure in low-carbon steel slabs (Yamashita and others, 2003); development of a reaction model for carbon, manganese, and oxygen in the final stage of steel refining by bottom blowing with mixed gas (Kato and Okuda, 2003); and thermodynamic properties of manganese in manganese-nickel-carbon alloys by using electromagnetic force measurements (Teng and others, 2003).

Lithium-Manganese Oxides.—A study on sodium precursor materials used to design layered manganese oxides for use as cathode material in lithium battery cells (Eriksson and others, 2003); and a report on using hydrothermally treated potassium permanganate to develop a new layered lithium-manganese-oxide cathode material (Nakano and others, 2003).

Manganese Ore Deposition.—Papers or extended abstracts published on the formation of manganese ore in the Hotazel iron formation of the Kalahri manganese field in South Africa (Gutzmer and others, 2003; Tsikos, 2003; Tsikos and others, 2003); a report on the effects of microbial activity in the formation of manganese wads at the Asahidake Hot Spring in Hokkaido, Japan (Mita and Miura, 2003); an investigation on the mineralogy and geochemistry of manganese nodules and crusts located in the western Carpathians (Rojkovič, Aubrecht, and Mišík, 2003); and a study on the origin of manganese carbonate ores in the early Oligocene deposits of the eastern Paratethys region (Kuleshov, 2003).

Nanotechnology.—Several studies on the use of manganese materials to produce different nanotechnologies, including nanotubes from rare-earth manganese-oxide-based compounds (manganites) for possible use in spin-polarized injection and as magnetic storage media (Levy and others, 2003); nanobelts converted from lithium manganese oxide powders for possible nanoelectronic and optoelectronic applications (Zhang and others, 2003); oriented nanobelts of manganese tetraoxide for potential use in nanocables and nanocomputers (Wang and others, 2003); and semiconductor nanocrystals from manganese-doped zinc sulfides for potential application in nonlinear optical devices (Jeon and others, 2003).

Outlook

The trend of domestic and global demand for manganese is expected to follow closely that of steel production. Although growth rates for some nonmetallurgical components of manganese demand, especially batteries, may be higher than for steel production, this situation will have only a minor effect on overall manganese demand.

From 1999 to 2003, U.S. apparent consumption of manganese has been within about plus or minus 11% of 699,000 t of contained manganese. This largely has been a consequence of a reasonably comparable degree of variation in domestic steel production. During this period, manganese apparent consumption has tended to increase or decrease at about the same rate as raw steel production during this period (table 1). However, manganese apparent consumption may not track steel production precisely because of the influence of unmeasured changes in stocks of manganese materials, such as those of importers and consumers. The effect of this may outweigh changes in demand by steelmakers and may explain why for some years calculated apparent consumption showed positive or negative deviations from that which could be estimated on the basis of steel production. This was certainly the case in 2003.

The outlook for the steel industry is discussed in the “Outlook” section of the “Iron and Steel” chapter of the 2003 USGS Minerals Yearbook. While raw steel production in 2003 increased by 2% in the United States compared with that of 2002, manganese apparent consumption decreased by 11% to 618,000 t in 2003 from a revised estimate of 696,000 t in 2002. Raw steel production in 2003 increased by 7% globally. According to the International Iron and Steel Institute (IISI) (2004§), global apparent consumption of finished steel products grew to 864 Mt in 2003 from 805 Mt in 2002, an increase of 7%. This increase was primarily attributed to steel consumption growth of 47 Mt in China; steel consumption in the rest of the world rose to 631 Mt in 2003 from 619 Mt in 2002, an increase of 2%. Outside of Asia, steel consumption in most regions of the world rose nominally, with the exception of Africa and North America, where steel consumption decreased by 2%. Globally, high-carbon ferromanganese consumption in 2004 was expected to increase by 7% to 2.42 Mt from a revised estimate of 2.254 Mt in 2003 (Metal Bulletin Research Ferro-alloys Monthly, 2004a). World silicomanganese consumption was projected to increase by 8% to 3.461 Mt in 2004 from a revised figure of 3.212 Mt in 2003 (Metal Bulletin Research Ferro-alloys Monthly, 2004b). The IISI projected that North America's gross domestic product and steel demand would rise by 3.7% and 5.3%, respectively, in 2004 compared with those of 2003 (Christmas, 2003§).

References Cited

Bakker, W.J.W., Kapteijn, Freek, and Moulijn, J.A., 2003, A high capacity manganese-based sorbent for regenerative high temperature desulfurization with direct sulfur production—Conceptual process application to coal gas cleaning: Chemical Engineering Journal, v. 96, no. 1, December 15, p. 223-235.

Barsukov, I.V., Doninger, J.E., Zaleski, P.L., Gallego, M.A., and Huerta, Tomás, 2003, Recent developments in graphitic materials for conductivity enhancement in primary and rechargeable alkaline batteries: ITE Letters on Batteries, New Technologies & Medicine (with News), v. 4, no. 2, p. 167-170.

Chemical Market Reporter, 2003, Kerr-McGee suspends manganese dioxide manufacture: Chemical Market Reporter, v. 263, no. 22, June 2, p. 3.

Chen, Wei-yiang, Chai, Li-yuan, Min, Xiao-bo, Peng, Bing, Zhang, Chuan-fu, and Dai, Yong-nian, 2003, Recycling of valuable metals from spent zinc-manganese batteries by vacuum metallurgy: Transactions (Nonferrous Metal Society of China), v. 13, no. 5, October, p. 1213-1216.

CRU Bulk Ferroalloys Monitor, 2003, Manganese—Silicomanganese prices gain further momentum in both Europe and especially in Asia as well as in the USA: CRU Bulk Ferroalloys Monitor, December 16, p. 10.

Dashevskii, V.Ya., Katsnelson, A.M., Makarova, N.N., Grigorovitch, K.V., and Kashin, V.I., 2003, Deoxidation equilibrium of manganese and silicon in liquid iron-nickel alloys: ISIJ International, v. 43, no. 10, p. 1487-1494.

Defense National Stockpile Center, 2003, FY 2003 annual materials plan (AMP) revision announced: Fort Belvoir, VA, Defense National Stockpile Center news release, December 23, 2 p.

Djurfors, B., Broughton, J.N., Brett, M.J., and Ivey, D.G., 2003, Microstructural characterization of porous manganese thin films for electrochemical supercapacitor applications: Journal of Materials Science, v. 38, no. 24, December 15, p. 4817-4830.

Dmitriev, A.N., Solomakhin, A.V., Kashin, V.V., and Verushkin, V.V., 2003, Making sinter from concentrate of low-grade manganese ore for use in the production of ferrosilicomanganese: Metallurgist, v. 47, nos. 3-4, March, p. 99-103.

Ehrlich, G.M., 2002, Lithium-ion batteries, in Linden, David, and Reddy, T.B., eds., Handbook of batteries (3d ed.): New York, NY, The McGraw-Hill Companies, Inc., p. 35.1-35.93.

Eriksson, T.A., Lee, Y.J., Hollingsworth, Joel, Reimer, J.A., Cairns, E.J., Zhang, Xiao-feng, and Doeff, M.M., 2003, Influence of substitution on the structure and electrochemistry of layered manganese oxides: Chemistry of Materials, v. 15, no. 23, November 18, p. 4456-4463.

Gutzmer, J., Schneiderhan, E., Beukes, N.J., Strauss, H., and Mezger, K., 2003, Unraveling chemostratigraphic signatures of sedimentation and diagenesis in Palaeoproterozoic iron and manganese formations: Applied Earth Science (Transactions Institution of Mining and Metallurgy), v. 112, August, p. B159-B161.

Harben, Peter, Raleigh, Charles, and Harris, Jeanette, 1998, Manganese uses & markets: London, United Kingdom, Industrial Minerals Information Ltd., 110 p.

Huang, C.C., Weng, Y.H., Lu, C.S., Yen, T.C., 2003, Dopamine transporter binding in chronic manganese intoxication: Journal of Neurology, v. 250, no. 11, p. 1335-1339.

Industrial Minerals, 2002, South Africa becoming an EMD powerhouse: Industrial Minerals, issue 420, September, p. 18.

Interfax Mining & Metals Report, 2003a, Komi Anganese Co. to build mill by 2006: Interfax Mining & Metals Report, v. 11, issue 6, February 7, p. 33.

Interfax Mining & Metals Report, 2003b, Pridniprovye buys 25% Nikopol Ferroalloys stake for $38.4 mln: Interfax Mining & Metals Report, v. 11, issue 22, May 30, p. 44.

International Trade Administration, 2003a, Antidumping or countervailing duty order, finding, or suspended investigation—Opportunity to request administrative review: Federal Register, v. 68, no. 84, May 1, p. 23281-23282.

International Trade Administration, 2003b, Initiation of antidumping and countervailing duty administrative reviews and request for revocation in part: Federal Register, v. 68, no. 126, July 1, p. 39055-39058.

International Trade Administration, 2003c, Notice of initiation of antidumping and countervailing duty administrative reviews and request for revocation in part—Correction: Federal Register, v. 68, no. 137, July 17, p. 42373.

International Trade Administration, 2003d, Silicomanganese from Brazil—Preliminary results of antidumping duty administrative review: Federal Register, v. 68, no. 207, October 27, p. 61185-61188.

International Trade Administration, 2004a, Notice of termination of antidumping duty investigations—Electrolytic manganese dioxide from Australia, Greece, Ireland, Japan, South Africa: Federal Register, v. 69, no. 41, March 2, p. 9799-9800.

International Trade Administration, 2004b, Silicomanganese from Brazil—Final results of antidumping duty administrative review: Federal Register, v. 69, no. 57, March 24, p. 13813-13814.

International Trade Administration, 2004c, Silicomanganese from Brazil—Notice of amended final results of antidumping duty administrative review: Federal Register, v. 69, no. 100, May 24, p. 29517-29518.

Jeon, H.J., Moon, S.D., Kang, Y.S., and Park, C.Y., 2003, Synthesis and characterization on the luminescence properties of manganese doped ZnS nanocrystals: Molecular Crystals and Liquid Crystals, v. 407, December, p. 49-56.

Kato, Yoshiei, and Okuda Haruji, 2003, Reaction model for carbon, manganese, and oxygen in bottom blowing with mixed gas in final stage of steel refining in converter: ISIJ International, v. 43, no. 11, p. 1710-1714.

Krivolapov, N.V., Zaitsev, A.K., and Valavin, V.S., 2003, Reduction of silicon and manganese in low- and no-iron slags by the carbon in hot metal: Steel in Translation, v. 33, no. 1, January, p. 1-5.

Kuleshov, V.N., 2003, Isotopic composition ($\delta^{13}C$, $\delta^{18}O$) and origin of manganese carbonate ores from the early Oligocene deposits, the eastern Paratethys: Chemie der Erde/Geochemistry, v. 63, no. 4, November, p. 329-363.

Levy, P., Leyva, A.G., Troiani, H.E., and Sanchez, R.D., 2003, Nanotubes of rare-earth manganese oxide: Applied Physics Letters, v. 83, no. 25, December, p. 5247-5249.

Liu, Y.Y., Imai, T., Ukita, M., Sekine, M., and Higuchi, T., 2003, Distributions of iron, manganese, copper and zinc in various composts and amended soils: Environmental Technology, v. 24, no. 12, December, p. 1517-1525.

MacArthur, D.M., and Blomgren, G.E., 2003, The Powers review—Year 2002 battery and fuel cell industry developments: Macomb, MI, Chemac International Corp., 100 p.

Mangum, William, 2003, Manganese greensand—A simple method of iron and manganese removal: Water Technology, v. 26, no. 11, November, p. 44, 46-47.

Metal Bulletin Research Ferro-alloys Monthly, 2004a, Global high-carbon ferro-manganese supply-demand balance: Metal Bulletin Research Ferro-alloys Monthly, issue 143, July 27, p. 8.

Metal Bulletin Research Ferro-alloys Monthly, 2004b, Global silico-manganese supply-demand balance: Metal Bulletin Research Ferro-alloys Monthly, issue 143, July 27, p. 8.

Miller, G.E., Ericson, J.E., Chan, T., Rinderknecht, A., and Kleinman, M.T., 2003, Tracking manganese exposure using INAA, invited: Transactions (American Nuclear Society), issue 89, p. 760.
Mining Journal, 2003, Bulgarian manganese boost: Mining Journal, v. 341, no. 8755, September 26, p. 240.
Mining Magazine, 1990, Manganese: Mining Magazine, v. 162, no. 1, January, p. 1-24.
Mita, Naioki, and Miura, Hiroyuki, 2003, Evidence of microbial activity in the formation of manganese wads at the Asahidake Hot Spring in Hokkaido, Japan: Resource Geology, v. 53, no. 3, p. 233-238.
Myers, J.E., Thompson, M.L., Naik, Inakshi, Theodorou, Penny, Esswein, Eric, Tassell, Halina, Daya, Aarti, Renton, Kevin, Spies, Adri, Paicker, Janice, Young, Taryn, Jeebhay, Mohamed, Ramushu, Suzan, London, Leslie, Rees, D.J., 2003a, The utility of biological monitoring for manganese in ferroalloy smelter workers in South Africa: NeuroToxicology, v. 24, issue 6, December, p. 875-883.
Myers, J.E., Thompson, M.L., Ramushu, Suzan, Young, Taryn, Jeebhay, Mohamed, London, Leslie, Esswein, Eric, Renton, Kevin, Spies, Adri, Boulle, Andrew, Naik, Inakshi, Iregren, Anders, and Rees, D.J., 2003b, The nervous system effects of occupational exposure on workers in a South African manganese smelter: NeuroToxicology, v. 24, issue 6, December, p. 885-894.
Naik, P.K., Nathsarma, K.C., Das, S.C., and Misra, V.N., 2003, Leaching of low grade Joda manganese ore with sulphur dioxide in aqueous medium: Transactions (Institution of Mining and Metallurgy), v. 112, August, p. 131-134.
Nakano, Hideyuki, Okuda, Chikaaki, and Ukyo, Yoshio, 2003, Cathodic behavior of layered manganese oxides from potassium permanganate for rechargeable lithium cells: Key Engineering Materials, v. 248, p. 143-146.
Peretyagin, V.A., and Pavlov, A.V., 2003, Mechanism of reduction in oxygen reactor for ore-coal pellets prepared with low-grade manganese ore: Metallurgist, v. 47, no. 11-12, November, p. 447-452.
Platts Metals Week, 2003, Eramet converts SiMn furnace to FeMn: Platts Metals Week, v. 74, no. 45, November 10, p. 10.
Ponnapakkam, Tulasi, Iszard, Marcus, and Henry-Sam, Gerelyn, 2003, Effects of oral administration of manganese on the kidneys and urinary bladder of Sprague-Dawley rats: International Journal of Toxicology, v. 22, no. 3, May-June, p. 227-232.
President of the United States, 2003, Presidential proclamation 7637 of January 10, 2003—To modify duty-free treatment under the Generalized System of Preferences: Federal Register, v. 68, no. 9, January 14, p. 1951-1954.
Rojkovič, Igor, Aubrecht, Roman, and Mišík, Milan, 2003, Mineral and chemical composition of manganese hardgrounds in Jurassic limestones of the western Carpathians: Geologica Carpathica, v. 54, no. 5, October, p. 317-328.
Ryan’s Notes, 2003a, New US manganese alloy plant—Highlanders gets another chance: Ryan’s Notes, v. 10, no. 16, April 21, p. 1.
Ryan’s Notes, 2003b, Nikopol names new US agent: Ryan’s Notes, v. 10, no. 22, June 2, p. 1.
Ryan’s Notes, 2003c, Questions on SiMn staying power: Ryan’s Notes, v. 9 [sic], no. 35, September 1, p. 1-2.
Teng, Lidong, Aune, Ragnhild, and Seetharaman, Seshadri, 2003, Study of Mn activities in Mn-Ni-C alloys by EMF measurements: Intermetallics, v. 11, no. 11, p. 1229-1235.
Tex Report, 2003, Eramet closed Fe-Mn production at Shaoxing Plant/China: Tex Report, v. 35, no. 8315, July 4, p. 4.
Toroghinezhad, M.R., Humphreys, A.O., Essadiqi, Elhachmi, Ashrafizadeh, Fakhraddin, Najafizadeh, Abbas, and Jonas, J.J., 2003, Effect of chromium, boron and manganese additions on the deformation and recrystallization textures of warm rolled low carbon steels: ISIJ International, v. 43, no. 11, p. 1842-1850.
Tsikos, Harilaos, 2003, Hydrothermal aegirine from the Palaeoproterozoic Hotazel iron-formation, Kalahari manganese field, South Africa, and its implications: Applied Earth Science (Transactions Institution of Mining and Metallurgy), v. 112, no. 2, August, p. 166-167.
Tsikos, Harilaos, Beukes, N.J., Moore, J.M., and Harris, Chris, 2003, Deposition, diagenesis, and secondary enrichment of metals in the Paleoproterozoic Hotazel iron formation, Kalahari manganese field, South Africa: Economic Geology, v. 98, no. 7, November, p. 1449-1462.
U.S. Environmental Protection Agency, 2003a, Announcement of regulatory determinations for priority contaminants on the drinking water contaminant list: Federal Register, v. 68, no. 138, July 18, p. 42897-42906.
U.S. Environmental Protection Agency, 2003b, National emission standards for hazardous air pollutants for brick and structural clay products manufacturing, and national emission standards for clay ceramics manufacturing—Final rule: Federal Register, v. 68, no. 95, May 16, p. 26690-26755.
U.S. Environmental Protection Agency, 2003c, National emission standards for hazardous air pollutants for chemical recovery combustion sources at kraft, soda, sulfite, and stand-alone semichemical pulp mills—Direct final rule and amendments: Federal Register, v. 68, no. 32, February 18, p. 7706-7718.
U.S. Environmental Protection Agency, 2003d, National emission standards for hazardous air pollutants—Integrated iron and steel manufacturing: Federal Register, v. 68, no. 97, May 20, p. 27646-27677.
U.S. Environmental Protection Agency, 2003e, National emission standards for hazardous air pollutants—Taconite iron ore processing: Federal Register, v. 68, no. 210, October 30, p. 61868-61903.
U.S. Environmental Protection Agency, 2003f, Standards for the use or disposal of sewage sludge—Final agency response to the National Research Council report on biosolids applied to land and the results of EPA’s review of existing sewage sludge regulations: Federal Register, v. 68, no. 250, December 31, p. 75531-75552.
U.S. International Trade Commission, 2003, Electrolytic manganese dioxide from Australia, China, Greece, Ireland, Japan, and South Africa: Federal Register, v. 68, no. 154, August 11, p. 47607-47608.
U.S. International Trade Commission, 2004, Electrolytic manganese dioxide from Australia, Greece, Ireland, Japan, and South Africa: Federal Register, v. 69, no. 46, March 9, p. 11040-11041.
Wang, Jisen, Sun, Jinquan, Bao, Ying, and Bian, Xiufang, 2003, Preparation of manganese oxide nanobelts: Journal of Materials Science and Technology, v. 19, no. 5, May, p. 489-491.
Weiss, S.A., 1977, Manganese—The other uses: London, United Kingdom, Metal Bulletin Books, Ltd., 360 p.
Wu, M.S., Wu, H.R., Wang, Y.Y., and Wan, C.C., 2003, Effects of the stoichiometric ratio of aluminum and manganese on electrochemical properties of hydrogen storage alloys: Journal of Applied Electrochemistry, v. 33, no. 7, July, p. 619-625.
Yasmashita, Teruo, Torizuka, Shiro, and Nagai, Kotobu, 2003, Effect of manganese segregation on fine-grained ferrite structure in low-carbon steel slabs: ISIJ International, v. 43, no. 11, p. 1833-1841.
Zhang, Lizhi, Yu, J.C., Xu, A.W., Li, Quan, Kwong, K.W., and Wu, Ling, 2003, A self-seeded, surfactant-directed hydrothermal growth of single crystalline lithium manganese oxide nanobelts from the commercial bulky particles: Chemical Communications (Royal Society of Chemistry), issue 23, November 18, p. 2910-2911.

Internet References Cited

Assmang Limited, 2004 (February 16), Group financial results for the half-year ended 31 December 2003, accessed August 6, 2003, at URL http://www.lucid.co.za/assmang/downloads/Interim-AOM.pdf.
Bradespar S.A., 2003 (June 30), CVRD’s Norwegian ferro alloys plant starts up operations, accessed July 21, 2003, via URL http://www.bradespar.com.br.
Companhia Vale do Rio Doce, 2003 (October 28), CVRD simplifies operation structure, Press Release, accessed February 2, 2004, via URL http://www.vale.com.br.
Christmas, Ian, 2003 (October 6), Short range outlook and medium term forecast, Remarks for the 37th International Iron and Steel Institute Annual Conference, accessed June 14, 2004, at URL http://www.worldsteel.org/media/docs/iisi37_sro.pdf.
Delta plc, 2004 (March 16), Annual report and accounts 2003, accessed August 6, 2004, at URL http://www.deltaplc.com/investors/annualreport03/rep05.html.
Eramet SA, 2003 (September 5), Official meeting with Comilog France’s workers representatives, Press Release, accessed September 22, 2003, via URL http://www.eramet.fr.

HiTec Energy Ltd., 2003a (May 20), Acquisition of existing production facilities enhances HiTec's electrofuel project, accessed January 16, 2004, at URL http://www.hitec-energy.com.au/hitecnews/news03/newsmay03.htm.
HiTec Energy Ltd., 2003b (September 30), HiTec Energy Ltd. quarterly report for the period ended 30 September 2003, accessed January 16, 2004, via URL http://www.hitec-energy.com.au.
Ieport Daily News, 2004 (May 31), Govt begins reviewing steel prices, exports, accessed July 28, 2004, via URL http://www.ieport.com.
India Ministry of Disinvestment, 2003 (May 12), Sale of 59.81% or more of the total voting equity share capital in Manganese Ore (India) Limited, Preliminary Information Memorandum, accessed June 25, 2003, via URL http://divest.nic.in.
International Iron and Steel Institute, 2004, World steel in figures, accessed July 14, 2004, at URL http://www.worldsteel.org/media/wsif/wsif2004.pdf.
Metal Pages, 2003 (May 28), New ferromanganese capacity at Kosogorsk, accessed May 30, 2003, at URL http://www.metal-pages.com/printnews.asp?newsid=10794.
Murtha, John, 2003 (April 22), Murtha joins in grand opening of Rollock division, accessed May 22, 2003, at URL http://www.house.gov/murtha/news/news.htm.
Office of the United States Trade Representative, 2003, U.S.-SACU [pending] free trade agreement—Summary, accessed June 25, 2004, at URL http://www.ustr.gov/new/fta/sacu.htm.
RTÉ News, 2003 (July 3), 92 jobs lost as Cork plant closes, accessed January 16, 2004, at URL http://www.rte.ie/news2/2003/0703/jobs.html.
South African National Treasury, 2003a (April 30), Extension of deadline for comments on the mineral and petroleum royalty bill, accessed April 28, 2003, via URL http://www.treasury.gov.za.
South African National Treasury, 2003b (March 10), Mineral and petroleum royalty bill, accessed April 28, 2003, via URL http://www.treasury.gov.za.
Sunday Business Post, 2003 (December 14), South Coast Transport buys 100-acre Cork site, accessed January 16, 2004, at URL http://archives.tcm.ie/businesspost/2003/12/14/story117114133.asp.
U.S. International Trade Commission, 2003a (September 12), ITC votes to continue cases on electrolytic manganese dioxide from Australia, Greece, Ireland, Japan, and South Africa, but not China, News Release 03-091, accessed September 22, 2003, via URL http://www.usitc.gov.
U.S. International Trade Commission, 2003b (April), U.S.-Southern African customs free trade agreement—Advice concerning the probable effect, Investigations Nos. TA-131-23 and TA-214-3, accessed June 20, 2003, via URL http://www.usitc.gov.
Yieh Trading Corporation Market News, 2003, Eramet closes Shaoxing plant to fit in gov't request, accessed July 21, 2003, via URL http://www.yiehtrading.com.

GENERAL SOURCES OF INFORMATION

U.S. Geological Survey Publications

Manganese. Ch. in Mineral Commodity Summaries, annual.
Manganese. Mineral Industry Surveys, monthly.
Manganese. International Strategic Minerals Inventory Summary Report, Circular 930-A, 1984.

Other

Advanced Battery Technology.
American Metal Market.
Annual reports of various companies.
Company news releases and reports.
Manganese. Ch. in Mineral Facts and Problems, U.S. Bureau of Mines Bulletin 675, 1985.
Platts Metals Week.

TABLE 1
SALIENT MANGANESE STATISTICS[1]

(Thousand metric tons, gross weight, unless otherwise specified)

	1999	2000	2001	2002	2003
United States:					
Manganese ore (35% or more Mn):					
Exports	4	10	9	15	18
Imports for consumption	460	447	358	427	347
Consumption[2]	479	486	425	360	398
Stocks, December 31, consumers[2]	172	226	138	151	156
Ferromanganese:					
Exports	12	8	9	9	11
Imports for consumption	312	312	251	275	238
Consumption	281	300	266	253	248
Stocks, December 31, consumers and producers	40	31	25	21	20
Consumption, apparent, manganese content[3]	719	768	692	696 r	618
Ore price, c.i.f.[4] U.S. ports dollars per metric ton unit	2.26	2.39	2.44	2.30	2.41
World, production of manganese ore	17,800	19,600	20,800	22,200 r	23,200 e

[e]Estimated. [r]Revised.
[1]Data are rounded to no more than three significant digits.
[2]Exclusive of iron and steel plants.
[3]Based on estimates of average content for all significant components except imports, for which content is reported.
[4]Cost, insurance, and freight.

TABLE 2
U.S. GOVERNMENT DISPOSAL AUTHORITIES AND INVENTORIES FOR MANGANESE MATERIALS AS OF YEAREND 2003[1]

(Metric tons, gross weight)

		Physical inventory[e]					
		Uncommitted			Sold,	
	Disposal	Stockpile	Nonstockpile		pending	Grand
Material	authority	grade	grade	Total	shipment	total
Natural battery ore	23,800	23,800	--	23,800	31,500	55,300
Synthetic manganese dioxide	2,730	2,730	--	2,730	--	2,730
Chemical ore	67,600	67,600	--	67,600	44,400	112,000
Metallurgical ore	680,000	368,000	312,000	680,000	210,000	890,000
High-carbon ferromanganese	700,000	700,000	--	700,000	24,500	725,000
Electrolytic metal	--	--	--	--	454	454

[e]Estimated. -- Zero.
[1]Data are rounded to no more than three significant digits; may not add to totals shown.

Source: Defense National Stockpile Center.

TABLE 3

DOMESTIC PRODUCERS OF MANGANESE PRODUCTS IN 2003

Company	Plant location	Products[1]			Type of process
		FeMn	SiMn	MnO_2	
Erachem Comilog	Baltimore, MD			X	Chemical.
Do.	New Johnsonville, TN			X	Electrolytic.
Highlanders Alloys LLC[2]	New Haven, WV	X	X		Electric furnace.
Eramet Marietta Inc.	Marietta, OH	X	X		Do.
Kerr-McGee Chemical LLC	Henderson, NV			X	Electrolytic.
Energizer Holdings, Inc., Eveready Battery Co.	Marietta, OH			X	Do.

[1]FeMn, ferromanganese; SiMn, silicomanganese; MnO_2, synthetic manganese dioxide.

[2]Product information obtained from various industry trade publications. Company ceased production in January 2003.

TABLE 4
U.S. CONSUMPTION, BY END USE, AND INDUSTRY STOCKS OF MANGANESE FERROALLOYS AND METAL IN 2003[1]

(Metric tons, gross weight)

End use	Ferromanganese: High carbon	Ferromanganese: Medium and low carbon	Ferromanganese: Total	Silicomanganese	Manganese metal
Steel:					
Carbon	118,000	66,800	185,000	56,300	419
High-strength, low-alloy	17,400	5,090	22,500	2,640	(2)
Stainless and heat-resisting	8,550	(2)	8,550	11,700	1,120
Full alloy	16,500	4,720	21,200	19,500	(2)
Unspecified[3]	1,140	452	1,600	738	1,140
Total	162,000	77,100	239,000	90,800	2,680
Cast irons	7,470	464	7,930	700	5
Superalloys	W	W	W	--	W
Alloys (excluding alloy steels and superalloys)	787	454	1,240	(4)	16,000 [5]
Miscellaneous and unspecified	--	W	W	(4)	W
Total consumption	170,000	78,000	248,000	91,500 [6]	18,700
Total manganese content[7]	132,000	62,600	195,000	62,700	18,700
Stocks, December 31, consumers and producers	8,320	12,100	20,500	6,050	689

W Withheld to avoid disclosing company proprietary data; included with "Alloys (excluding alloy steels and superalloys)." -- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Withheld to avoid disclosing company proprietary data; included with "Steel, unspecified."

[3]Includes electrical and tool steel, and items indicated by footnote (2).

[4]Withheld to avoid disclosing company proprietary data.

[5]Approximately 85% of this combined total was for consumption in aluminum alloys.

[6]Internal evaluation indicates that silicomanganese consumption is considerably understated.

[7]Estimated based on typical percent manganese content.

TABLE 5

U.S. EXPORTS OF MANGANESE ORE, FERROALLOYS, AND METAL, BY COUNTRY[1]

Country	2002		2003	
	Quantity, gross weight (metric tons)	Value, f.a.s.[2] (thousands)	Quantity, gross weight (metric tons)	Value, f.a.s.[2] (thousands)
Ore and concentrates with 20% or more manganese:				
Canada	2,820	$654	2,620	$697
China	1,190	581	--	--
France	--	--	8,890	272
Germany	2,150	427	1,870	917
Italy	1,670	346	1,160	310
Mexico	2,520	832	--	--
Netherlands	1,710	362	204	100
Norway	513	229	555	272
United Kingdom	265	130	609	298
Other	2,130	543	2,310	715
Total	15,000	4,100	18,200	3,580
Ferromanganese, all grades:				
Canada	8,120	5,390	9,240	7,800
Mexico	947	694	78	87
Venezuela	7	3	1,260	904
Other	150	214	38	46
Total	9,230	6,300	10,600	8,840
Silicomanganese:				
Canada	334	197	251	238
Mexico	67	63	223	175
Other	122	179	132	141
Total	523	439	606	554
Metal, including alloys and waste and scrap:				
Belgium	502	1,660	395	658
Canada	174	488	523	1,260
Japan	1,120	2,710	806	1,710
Mexico	89	229	295	578
Sweden	141	354	180	145
Other	183 [r, 3]	560 [r, 3]	145	439
Total	2,200	6,000	2,340	4,790

[r]Revised.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Free alongside ship.

[3]Revised April 18, 2005.

Source: U.S. Census Bureau.

TABLE 6

U.S. IMPORTS FOR CONSUMPTION OF MANGANESE ORE, FERROALLOYS, METAL, AND SELECTED CHEMICALS, BY COUNTRY[1]

	2002			2003		
	Quantity		Value,	Quantity		Value,
	Gross weight	Mn content	customs	Gross weight	Mn content	customs
Country	(metric tons)	(metric tons)	(thousands)	(metric tons)	(metric tons)	(thousands)
Ore and concentrates with 20% or more manganese:						
All grades:						
Australia	34,700	18,400	$3,340	24,500	12,900	$2,140
Brazil	30,000	12,900	682	17	7	12
Gabon	272,000	140,000	19,000	239,000	123,000	19,300
Mexico	2,910	1,100	232	3,980	1,520	351
South Africa	86,500	41,800	5,740	78,900	36,900	5,070
Other	251	191	199	531	340	203
Total	427,000	214,000	29,200	347,000	175,000	27,000
More than 20% but less than 47% manganese:						
Brazil	29,900	12,800	682	17	7	12
China	--	--	--	217	98	46
Gabon	45,100	19,800	1,990	--	--	--
Mexico	2,910	1,100	232	3,940	1,500	315
South Africa	--	--	--	13,200	5,410	708
Total	77,900	33,700	2,900	17,400	7,010	1,080
47% or more manganese:						
Australia	34,700	18,400	3,340	24,500	12,900	2,140
Gabon	227,000	120,000	17,000	239,000	123,000	19,300
South Africa	86,500	41,800	5,740	65,700	31,500	4,360
Other	319	259	199	353	271	193
Total	349,000	180,000	26,300	330,000	168,000	26,000
Ferromanganese:						
All grades:						
Australia	2,510	1,900	728	7,350	5,690	2,950
Brazil	27,900	21,900	11,800	23,500	18,400	8,640
China	4,920	4,150	3,730	12,500	10,600	9,610
France	39,100	31,600	14,800	34,000	26,700	13,500
India	27,700	21,100	11,300	--	--	--
Japan	2,720	1,630	1,980	5,840	4,720	4,190
Korea, Republic of	6,900	5,510	3,470	2,540	2,070	1,570
Mexico	8,440	6,740	6,280	14,600	11,400	11,200
Norway	3,030	2,390	1,600	8,910	7,230	5,520
South Africa	144,000	116,000	64,400	128,000	100,000	59,700
Ukraine	5,890	3,030	2,320	--	--	--
Other	2,100	1,600	1,490	660	52	421
Total	275,000	218,000	124,000	238,000	187,000	117,000
1% or less carbon:						
China	2,280	2,050	2,220	5,110	4,580	4,760
Japan	2,700	1,620	1,960	5,840	4,720	4,190
Mexico	58	48	79	4,820	3,800	4,170
Norway	552	448	422	2,130	1,730	1,300
South Africa	4,840	4,450	5,780	3,980	3,690	4,680
Other	1,080	908	799	561	453	369
Total	11,500	9,510	11,300	22,400	19,000	19,500
More than 1% to 2% or less carbon:						
Brazil	1,790	1,440	989	--	--	--
China	2,640	2,100	1,510	7,410	5,970	4,850
Korea, Republic of	4,400	3,610	2,440	2,500	2,030	1,530
Mexico	8,380	6,690	6,200	9,720	7,570	6,980
Norway	2,480	1,940	1,180	6,780	5,500	4,230
South Africa	25,500	20,700	13,700	22,100	18,000	15,100
Other	794	519	574	--	--	--
Total	46,000	37,000	26,600	48,600	39,100	32,600
More than 2% but not more than 4% carbon:						
Mexico	--	--	--	22	21	11
South Africa	--	--	--	37	29	16
Ukraine	5,890	3,030	2,320	--	--	--
Total	5,890	3,030	2,320	59	50	27

See footnotes at end of table.

TABLE 6--Continued

U.S. IMPORTS FOR CONSUMPTION OF MANGANESE ORE, FERROALLOYS, METAL, AND SELECTED CHEMICALS, BY COUNTRY[1]

Country	2002 Quantity Gross weight (metric tons)	2002 Quantity Mn content (metric tons)	2002 Value, customs (thousands)	2003 Quantity Gross weight (metric tons)	2003 Quantity Mn content (metric tons)	2003 Value, customs (thousands)
Ferromanganese--Continued:						
More than 4% carbon:						
Australia	2,510	1,900	$728	7,350	5,690	$2,950
Brazil	26,100	20,400	10,800	23,500	18,400	8,640
France	39,100	31,600	14,800	34,000	26,700	13,500
India	27,700	21,100	11,300	--	--	--
South Africa	114,000	91,000	45,000	102,000	78,800	39,900
Other	2,750	2,090	1,170	178	142	102
Total	212,000	168,000	83,800	167,000	130,000	65,200
Silicomanganese:						
Australia	47,900	32,000	19,700	47,700	31,600	20,500
France	4,000	2,640	1,890	1,910	1,270	1,050
Georgia	14,600	10,600	7,080	20,600	18,300	10,100
Mexico	7,850	5,130	3,780	11,600	7,710	5,870
Norway	13,100	7,730	7,940	28,400	17,300	18,400
Romania	22,600	15,400	10,800	34,000	24,600	17,200
South Africa	118,000	79,100	50,800	108,000	72,200	51,400
Spain	1,930	1,500	1,240	5,800	3,770	3,310
Other	16,300 r	10,700 r	7,730 r	9,460	5,500	4,830
Total	247,000	165,000	111,000	267,000	182,000	133,000
Metal:						
Unwrought[2]:						
China	6,100	XX	4,860	5,490	XX	4,890
Germany	3,600	XX	4,470	153	XX	217
South Africa	12,200	XX	15,100	11,300	XX	13,000
Other	193	XX	312	27	XX	34
Total	22,100	XX	24,800	17,000	XX	18,200
Other manganese, wrought:						
China	113	XX	154	761	XX	843
Netherlands	73	XX	135	9	XX	16
Spain	--	XX	--	514	XX	813
Other	119	XX	638	131	XX	631
Total	305	XX	927	1,420	XX	2,300
Waste and scrap:						
Canada	3,360	XX	545	1,330	XX	230
France	3,730	XX	711	39	XX	75
Mexico	--	XX	--	3	XX	2
South Africa	82	XX	123	--	XX	--
Total	7,180	XX	1,380	1,370	XX	307
Manganese dioxide:						
Australia	22,000	XX	30,200	29,000	XX	35,900
China	1,170	XX	1,340	551	XX	556
Greece	1,480	XX	1,910	1,250	XX	1,480
Ireland	6,550	XX	8,680	6,610	XX	8,160
South Africa	2,900	XX	4,170	8,700	XX	11,100
Other	2,560	XX	4,410	3,260	XX	4,560
Total	36,700	XX	50,700	49,400	XX	61,800
Potassium permanganate:						
Czech Republic	721	XX	1,390	889	XX	1,720
India	372	XX	738	576	XX	1,130
Other	448 r	XX	629 r	2	XX	25
Total	1,540	XX	2,760	1,470	XX	2,880

rRevised. XX Not applicable. -- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Imports of unwrought metal include flake, powder, and other.

Source: U.S. Census Bureau, adjusted by the U.S. Geological Survey.

TABLE 7

MANGANESE ORE: WORLD REFINERY PRODUCTION, BY COUNTRY[1, 2]

(Thousand metric tons)

Country[3]	Mn content[e, 4] (percentage)	1999	2000	2001	2002	2003[e]
Australia:[5]						
Gross weight		1,892	1,614	2,069	2,187	2,555 [6]
Mn content	37-53	926	787	948	983	1,247 [6]
Brazil:[7]						
Gross weight		1,656	1,925	1,863	2,529 [r]	2,600
Mn content	37	619 [r]	719 [r]	657 [r]	936 [r]	990
China:[e, 8]						
Gross weight		3,190	3,500	4,300	4,500	4,000
Mn content	20-30	630	700	860	900	800
Gabon:[9]						
Gross weight		1,908	1,743	1,791	1,856	2,000
Mn content	45-53	881	804	830 [e]	810 [e]	873
Ghana:						
Gross weight		639 [10]	896 [e, 10]	1,077	1,136	1,200
Mn content[e]	32-34	204 [6]	287	344	363	383
India:[e, 11]						
Gross weight		1,500	1,550	1,600	1,700	1,650
Mn content	10-54	570	590	600	630	620
Kazakhstan, crude ore:						
Gross weight		980	1,136	1,387	1,792	2,361 [6]
Mn content[e]	20-30	240	280	350	440	580
Mexico:[12]						
Gross weight		459	435	277	233	310
Mn content	27-50	169	156	100	88	112 [6]
South Africa:[9]						
Gross weight		3,122	3,635	3,266	3,322	3,501 [6]
Mn content	30-48+	1,343	1,578	1,479	1,504	1,585 [6]
Ukraine:						
Gross weight		1,985	2,741	2,700	2,470 [r]	2,591 [6]
Mn content[e]	30-35	675	930	930	840 [r]	880 [6]
Other:[e, 13]						
Gross weight		458 [r]	433 [r]	490 [r]	465 [r]	455
Mn content	XX	134 [r]	125 [r]	150 [r]	145 [r]	139
Total:						
Gross weight		17,800	19,600	20,800	22,200 [r]	23,200
Mn content	XX	6,390 [r]	6,960 [r]	7,250 [r]	7,640 [r]	8,210

[e]Estimated. [r]Revised. XX Not applicable.

[1]World totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]Table includes data available through July 27, 2004. Data pertain to concentrates or comparable shipping product, except that, in a few instances, the best data available appear to be for crude ore, possibly after some upgrading.

[3]In addition to the countries listed, Cuba, Panama, and Sudan may have produced manganese ore and/or manganiferous ore, but available informatio is inadequate to make reliable estimates of output levels.

[4]May be average content of each year's production rather than for content of typical products.

[5]Metallurgical ore.

[6]Reported figure.

[7]Production of beneficiated ore as reported in Mineral Summary, Brasilia, Brazil.

[8]Includes manganiferous ore.

[9]Calculated metal content includes allowance for assumed moisture content. Includes ore and sinter.

[10]Sales.

[11]Much of India's production grades below 35% Mn; content averaged 38.3% Mn for fiscal years 1998-99 through 2003-04.

[12]Mostly oxide nodules; may include smaller quantities of direct-shipping carbonate and oxide ores for metallurgical and battery operations.

[13]Category represents the combined totals of Bosnia and Herzegovina, Bulgaria, Burkina Faso, Burma, Chile, Colombia, Egypt, Georgia, Hungary, Indonesia, Iran, Italy (from wastes), Morocco, Namibia, Romania, Russia (crude ore), Thailand, and Turkey.

TABLE 8

FERROMANGANESE AND SILICOMANGANESE: WORLD PRODUCTION, BY COUNTRY[1, 2]

(Metric tons, gross weight)

Country[3]	1999	2000	2001	2002	2003[e]
Argentina, electric furnace, silicomanganese	--	4,900	5,150	5,000 [e]	5,000
Australia, electric furnace:[e]					
Ferromanganese	98,000	115,000	115,000	115,000	115,000
Silicomanganese	116,000	135,000	135,000	135,000	135,000
Total	214,000	250,000	250,000	250,000	250,000
Brazil, electric furnace:					
Ferromanganese	110,000 [r]	121,277	96,016	149,000 [r]	145,000
Silicomanganese	116,822	171,304	180,235	180,200 [r]	180,000
Total	226,822 [r]	292,581	276,251	329,200 [r]	325,000
Chile, electric furnace:					
Ferromanganese	2,833	4,011	2,213 [r]	2,500 [r, e]	2,600
Silicomanganese	2,048	1,800	1,800 [e]	1,800 [e]	1,800
Total	4,881	5,811	4,013 [r]	4,300 [r, e]	4,400
China:[e]					
Blast furnace, ferromanganese	550,000	500,000	500,000	500,000	550,000
Electric furnace:					
Ferromanganese	550,000	520,000	670,000	490,000 [r]	700,000
Silicomanganese	822,000	900,000	1,170,000	1,580,000 [r]	1,800,000
Total	1,920,000	1,920,000	2,340,000	2,570,000 [r]	3,050,000
Egypt, electric furnace, ferromanganese[e]	30,000	30,000	30,000	30,000	30,000
France:[e]					
Blast furnace, ferromanganese	302,000	300,000	300,000	300,000	180,000
Electric furnace:					
Ferromanganese	138,000	140,000	130,000	130,000	120,000
Silicomanganese[4]	55,000	60,000	50,000	50,000	107,000
Total	495,000	500,000	480,000	480,000	407,000
Georgia, electric furnace:[e]					
Ferromanganese	6,500	7,000	7,000	7,000	7,000
Silicomanganese	25,000	25,000	25,000	25,000	25,000
Total	31,500	32,000	32,000	32,000	32,000
India, electric furnace:[e]					
Ferromanganese	160,000	160,000	165,000	165,000	165,000
Silicomanganese	190,000	185,000	150,000	150,000	160,000
Total	350,000	345,000	315,000	315,000	325,000
Indonesia, electric furnace:[e]					
Ferromanganese	12,000	12,000	12,000	12,000	12,000
Silicomanganese	7,000	7,000	7,000	7,000	7,000
Total	19,000	19,000	19,000	19,000	19,000
Italy, electric furnace:[e]					
Ferromanganese	19,000	40,000	40,000	40,000	40,000
Silicomanganese	67,000	90,000	90,000	90,000	90,000
Total	86,000	130,000	130,000	130,000	130,000
Japan, electric furnace:					
Ferromanganese	315,152	337,694	368,293	356,717	375,000
Silicomanganese	65,744	67,926	62,238	70,965	60,000
Total	380,896	405,620	430,531	427,682	435,000
Kazakhstan, electric furnace:					
Ferromanganese	--	1,075	5,349	2,278	1,931 [5]
Silicomanganese	78,495	102,719	141,200	164,000	178,920 [5]
Total	78,495	103,794	146,549	166,278	180,851 [5]
Korea, North, electric furnace, ferromanganese[e]	6,000	6,000	6,000	6,000	6,000
Korea, Republic of, electric furnace:					
Ferromanganese	140,208	146,373	143,525	137,000 [r, e]	140,000
Silicomanganese	116,091	103,522	101,877	94,000 [r, e]	100,000
Total	256,299	249,895	245,402	231,000 [r, e]	240,000

See footnotes at end of table.

TABLE 8--Continued

FERROMANGANESE AND SILICOMANGANESE: WORLD PRODUCTION, BY COUNTRY[1, 2]

(Metric tons, gross weight)

Country[3]	1999	2000	2001	2002	2003[e]
Mexico, electric furnace:[6]					
Ferromanganese	79,552	90,501	60,014	38,532 [r]	55,903 [5]
Silicomanganese	113,917	107,923	74,290	73,263 [r]	81,223 [5]
Total	193,469	198,424	134,304	111,795 [r]	137,126 [5]
Norway, electric furnace:[e]					
Ferromanganese	235,000	235,000	240,000	240,000	245,000
Silicomanganese	230,000	230,000	230,000	230,000	230,000
Total	465,000	465,000	470,000	470,000	475,000
Poland:					
Blast furnace, ferromanganese[e]	100	--	500	600 [r]	600
Electric furnace, silicomanganese	10,000	19,000	20,000	7,000 [r, e]	10,000
Total	10,100	19,000	20,500	7,600 [r, e]	10,600
Romania, electric furnace:					
Ferromanganese	25	1,044	384	--	--
Silicomanganese	550 [e]	21,158	71,921	88,665	85,000
Total	575	22,202	72,305	88,665	85,000
Russia, blast furnace, ferromanganese[e]	90,000	70,700	70,000	80,000	85,000
Slovakia, electric furnace:[e]					
Ferromanganese	20,000	20,000	20,000	20,000	20,000
Silicomanganese	35,000	35,000	35,000	35,000	35,000
Total	55,000	55,000	55,000	55,000	55,000
South Africa, electric furnace:					
Ferromanganese	527,000	596,873	498,000	619,000 [r]	650,000
Silicomanganese	267,000	310,000	253,000	276,000 [r]	375,000
Total	794,000	906,873	751,000	895,000 [r]	1,030,000
Spain, electric furnace:[e]					
Ferromanganese	10,000	10,000	10,000	10,000	10,000
Silicomanganese	95,000	100,000	100,000	100,000	100,000
Total	105,000	110,000	110,000	110,000	110,000
Ukraine:					
Blast furnace, ferromanganese[e]	57,800	85,400	85,000	85,000	85,000
Electric furnace:					
Ferromanganese	199,539	252,679	231,000	250,617 [r]	250,000
Silicomanganese	498,905	684,040	702,389	732,592 [r]	740,000
Total	756,244	1,022,119	1,018,389	1,068,209 [r]	1,080,000
United States, electric furnace, ferromanganese[7]	W	W	W	W	W
Venezuela, electric furnace:					
Ferromanganese	10,694	15,655	12,715	12,000 [e]	12,000
Silicomanganese	47,635	69,735	56,640	36,974 [r]	30,632 [5]
Total	58,329	85,390	69,355	48,974 [r]	42,632 [5]
Grand total	6,630,000 [r]	7,250,000	7,480,000 [r]	7,930,000 [r]	8,540,000
Of which:					
Blast furnace, ferromanganese	1,000,000	956,000	956,000	966,000	901,000
Electric furnace, excluding United States:					
Ferromanganese[8]	2,670,000 [r]	2,860,000	2,860,000 [r]	2,830,000 [r]	3,100,000
Silicomanganese[9]	2,960,000	3,430,000	3,660,000 [r]	4,130,000 [r]	4,540,000

[e]Estimated. [r]Revised. W Withheld to avoid disclosing company proprietary data; not included in "Grand total." -- Zero.

[1]World totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]Table includes data available through August 20, 2004.

[3]In addition to the countries listed, Iran is believed to have produced ferromanganese and silicomanganese, but production information is inadequate for the formulation of estimates of output levels.

[4]Includes silicospiegeleisen, if any.

[5]Reported figure.

[6]Salable products from Cía Minera Autlán S.A. de C.V.

[7]U.S. output of ferromanganese includes silicomanganese.

[8]Ferromanganese includes silicomanganese, if any, for North Korea.

[9]Includes silicospiegeleisen, if any, for France.